Systems Thinking Workshop Glossary

Adaptation: In Darwinian evolution, adaptation refers to the ongoing process whereby an organism become fit or adapted to a changing environment. A fundamental concept of complex adaptive systems is their capacity to adapt by changing the rules of interaction among their component parts or agents. In that way, adaptation can consist of learning new rules or guidelines for behavior.

Boundaries (also called Containers): Boundaries act to demarcate or delineate a system from its environment and thereby maintain the system's identity as it changes. Boundaries/containers can be geographical (a physical location or campus), organizational (a department or function), behavioral (professional identification or culture), or conceptual (policies, goals, mission or purpose, and rules or budgets).

Butterfly effect: This refers to a small change having a huge effect, such as a butterfly flapping its wings in South America eventually leading to a thunderstorm in North America. It is an example of sensitive dependence on initial conditions in random or chaotic systems, which introduces a great amount of unpredictability into a system.

Causal Loops (also called Feedback): Causal loops are the circular or recursive interactions among parts or components of a system. Balancing (negative) feedback is when two subsystems interact to dampen the output of the other. For example, an increase in the number of predators can lead to a decline in the population of prey. Reinforcing (positive) feedback occurs when two subsystems are amplifying or magnifying each other's outputs. For example, placing a microphone too close to a speaker amplifies the sound from the speaker; the speaker, in turn, amplifies the sound from the microphone; the reinforcing pattern escalates until there is a loud screech.

Container, Difference, Exchange (CDE) Model: CDE is a human systems dynamics theory developed by Glenda Eoyang, executive director of the Human Systems Dynamics Institute, which describes three conditions (containers, differences, and transforming exchanges) that influence the speed, path, and power of the system-wide patterns that emerge through the interactions of agents in a complex adaptive system.

Co-evolution: The coordinated and interdependent evolution of two or more systems within a larger ecological system. There is feedback among the systems in terms of competition or cooperation and different utilization of the same limited resources. An example is the way in which alterations in a predator will alter the adaptive possibilities of the prey. Businesses or institutions can also coevolve in various ways with their suppliers, receivers, funders, markets, communities, and competitors.

Complexity Theory: In contrast to simple, linear and equilibrium-based systems, complex phenomena are characterized by nonlinear, interactive components, emergent phenomena, continuous and discontinuous change, and unpredictable outcomes. This theory builds on cybernetics and general systems theory.

Complex Adaptive System (CAS): A CAS is a complex, nonlinear, interactive system that has the ability to adapt to a changing environment. Such systems are characterized by the potential for organic, self-organization in a non-equilibrium environment. In a CAS, many semi-independent and diverse agents, who are free to act in unpredictable ways, continually interact with each other, adapting to each other and to the environment as a whole, creating system-wide patterns.

Cybernetics: The term cybernetics derives from a Greek word which meant steersman, and which is the origin of English words such as "govern". Cybernetics is the study of feedback concepts such as communication and control in living organisms, machines and organizations. Its focus is how anything (digital, mechanical or biological) processes information, reacts to information and changes or can be changed to better accomplish the first two tasks.

Differences: Significant differences or diversity in the parts of a system can determine the primary patterns that emerge during organic, self-organization processes. A difference between two parts or agents may be reflected and reinforced by other agents in the system, which then establishes a system-wide pattern. Examples of significant differences include: power, levels of expertise, quality, cost, gender, race, and education.

Dynamical System: In contrast to a dynamic system, in which the system moves in a smooth trajectory under linear forces in a closed environment, a dynamical system moves in unpredictable ways under high dimension, nonlinear forces in an open environment. Unlike static states, dynamical systems are in engaged in changing, evolving processes, increasing in complexity.

Emergence: Emergence is the arising of new, unexpected phenomena (structures, patterns, properties or processes) in an organic, self-organizing system. These emergent phenomena exist at a higher level than the lower-level parts or components from which they emerged. In organizations, emergent phenomena are occurring all the time, but their significance can be diminished or downplayed by control mechanisms generated by the corporate hierarchy. Two challenges for leaders are: (1) how to facilitate new emergent structures and (2) how to take advantage of ones that are occurring spontaneously.

Equilibrium: Equilibrium is the rest state of a system and is equated with stability, a system that is largely unaffected by internal or external changes. It easily returns to its original condition after being disturbed, maintaining the status quo.

Focus/purpose/direction: Focus may refer to specific short and/or long-term outcomes that are sought, a general direction in which a system is moving, or a combination. Some argue that without a common purpose or focus, a system is no more than a collection of parts.

General Systems Theory (GST): A biologist, Karl Ludwig von Bertalanffy developed General Systems Theory, which focuses open systems (a system where matter or energy can flow into and/or out of the system), emergence, boundaries and nested system hierarchies, and emphasizes holism over reductionism, and organisms over mechanisms.

Nonlinearity: In linear systems, the parts or components are isolated and non-interactive. Small changes result in small effects and large changes result in large effects. However, in nonlinear systems, the parts or components are interactive, interdependent, and exhibit feedback effects. Small changes can result in large effects (the butterfly effect – sensitive dependence on initial conditions); conversely, large changes can have small effects.

Perspectives: System perspectives refer to stakeholders' worldviews and purposes. System agents who have different perspectives may pursue different purposes within a given situation, or may have different views . Differences in perspectives can lead to patterns of (mis)alignment of purposes and processes within and across system levels.

Relationships (also called Transforming Exchanges): Transforming exchanges form the connections between the parts or agents of a system. Information, money, energy, and other resources are the media for transforming exchanges. As such resources flow from agent to agent, each is transformed in some way. These patterns of individual change lead, ultimately, to adaptability of the system as a whole. Ways to build transforming exchanges include: face-to-face meetings, e-mail, delivery of products and services, financial transactions, memos, and phone calls. In an organization, agents can build on ideas, actions, and events that result from group interactions.

Self-organization: A process in a complex system in which new emergent phenomena (structures, patterns, or processes) arise without being externally imposed on the system. Not controlled by a hierarchical command-and-control center, self-organization is usually distributed throughout the system. This concept is used to understand emergent collective behavior in a wide variety of systems including: the economy, the brain and nervous system, the immune system, large ecosystems, and modern large corporations or institutions.

Simple Rules: They are the minimum set of guidelines or norms that circumscribe the behavior in a system. If all the parts or agents in a system follow the same guidelines for behavior, then each one adapts to his/her immediate and local circumstances effectively, while remaining a part of the larger system. Examples include: an ant colony (keep foraging as long as incoming food is accepted by the other ants in the colony), driving on a crowed highway (stay in my lane; leave two car lengths in front of me; match my speed to others), and participating in a collaborative meeting (listen twice, speak once; make expectations explicit; and say "thank you").

Soft Systems: This approach applies techniques from systems engineering and operations research to human systems. Methods developed by Churchman, Ackhoff, Checkland, Ulrich and others addressed issues including multiple perspectives, power and control, intractable problems with no simple solution.

System Definition: Different definitions emphasize different system attributes. Systems are defined as a group of interacting, interrelated, and interdependent elements forming a complex whole. Another definition describes a system as a configuration of parts connected and joined together by a web of relationships. All definitions focus on system integrity –the whole system is different from, and greater than, the sum of its parts, elements, or agents.

Systemness: Defined as "the degree to which something shares the attributes of a system, to arrange according to a system," this term is used in healthcare for the integration of healthcare systems through coordination, teamwork, shared learning, shared responsibility, a long-term perspective and alignment of financial incentives, in contrast with current healthcare delivery systems that are uncoordinated, fragments, and silo'd.

System of Care: "System of care" is an adaptive network of structures, processes, and relationships grounded in system of care values and principles that provides families (i.e. children and youth with serious emotional disturbances and their families to access to and available of necessary services and supports across administrative and funding jurisdictions. It is involves collaboration across agencies, families, and youth for the purpose of improving access and expanding the array of coordinated community-based services and supports.

Systems Dynamics: This approach was developed by Jay Forrester, Donella Meadows, and Peter Senge, this approach uses computer simulations and modeling of systems that have a great deal of feedback and circularity, including reinforcing and balancing loops, use of mental models, and system archetypes.

Systems Thinking: This is a way of understanding reality that emphasizes the relationships among a system's parts, rather than the parts themselves. It is also concerned about the interrelationships among parts and their relationship to a functioning whole. The focus is on seeing the underlying patterns and deep structures to system trends and events.

The glossary's terms and definitions were adapted from sources listed below:

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